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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/688,416	10/17/2003	David Charles Schwartz	960296.00129	2216

27114 7590 06/06/2007
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EXAMINER

MUMMERT, STEPHANIE KANE

ART UNIT	PAPER NUMBER
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1637

NOTIFICATION DATE	DELIVERY MODE
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06/06/2007

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

pat-dept@quarles.com

Office Action Summary	Application No. 10/688,416	Applicant(s) SCHWARTZ ET AL.	
	Examiner Stephanie K. Mummert, Ph.D.	Art Unit 1637	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 February 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-94 is/are pending in the application.
- 4a) Of the above claim(s) 71-94 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1-70 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>8/16/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

The Examiner of record for this case has changed. Please address all future correspondence to Examiner Stephanie Mummert, whose contact information is included at the conclusion of this communication.

Election/Restrictions

1. Applicant's election with traverse of Group I, claims 1-70 in the reply filed on February 16, 2007 is acknowledged. The traversal is on the ground(s) that the Examiner has not shown that the apparatus of Group I can be used with a materially different process. Applicant asserts that "the examiner has provided no basis for alleging the suitability of the apparatus for cell sorting, or for the ability of cells to migrate in the micro-channels. Further, the purpose of the apparatus of Group III, if used in any of the alleged materially different methods, would be to achieve fixing and straightening afforded by the methods of Group 1" (p. 1-2 of remarks). First, applicant's assertion that the examiner has provided no basis for alleging the suitability of the apparatus for cell sorting, it is noted that the examiner provided a materially different process that can be practiced using the apparatus, comprising an optical mapping surface and an elastic channel. Second, Applicant's arguments regarding the use of the apparatus would only be to achieve fixing and straightening are also not found persuasive because applicant is reading an intended use into the apparatus claims. If the apparatus as described and claimed can be used for a materially different method or process, as established in the previously mailed requirement, the two groups are independent and distinct.

The requirement is still deemed proper and is therefore made FINAL.

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2. Claims 89-93 and 71-88 and 94 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on February 26, 2007.

Claims 1-70 are pending and will be examined.

Information Disclosure Statement

The information disclosure statement (IDS) submitted on August 16, 2004 was filed in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner. It is noted that entire pages were crossed out due to substantial duplication of the references listed on the previous IDS pages.

Priority

The later-filed application must be an application for a patent for an invention which is also disclosed in the prior application (the parent or original nonprovisional application or provisional application). The disclosure of the invention in the parent application and in the later-filed application must be sufficient to comply with the requirements of the first paragraph of 35 U.S.C. 112. See *Transco Products, Inc. v. Performance Contracting, Inc.*, 38 F.3d 551, 32 USPQ2d 1077 (Fed. Cir. 1994).

The disclosure of the prior-filed application, Application No. 60/419,884 and the disclosure of the prior patents, 5,720,928, 6,294,136, and 6,610,256, fail to provide adequate support or enablement in the manner provided by the first paragraph of 35 U.S.C. 112 for one or

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more claims of this application. Claims 10-16, 32-38 and 50-56 recite the claim limitation “periodically reversing the flow to cause the polymeric molecules to hover in an elongated/aligned or separated state”. This claim limitation does not have support in the disclosures of the applications or patents to which priority is claimed. The claims are being granted the filing date of the instant application, October 17, 2003.

Claims 49-70 recite or are dependent from a claim that recites the claim limitation “separate the elongated molecules by their relative speeds within the laminar flow”. This claim limitation does not have support in the disclosures of the previously issued patents noted above nor is the support for this limitation evident in the prior filed application 60/419884. While each of these patents disclose the separation of polymeric molecules, there is no discussion or support of separating the elongated molecules by their relative speeds in the laminar flow. These claims are also being granted the filing date of the instant application, October 17, 2003.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned

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with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

4. Claim 1, 4-7, 17, 25, 28-31, 39, 45-47 and 48 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 1 of U.S. Patent No. 7,049,074, issued May 23, 2006 ('074 patent herein). Although the conflicting claims are not identical, they are not patentably distinct from each other.

5. Claim 1 of the '074 patent is directed to a method of elongating and fixing a nucleic acid molecule on a planar surface coated with a positively charged substance and the density of said positively charged substance is sufficient that nucleic acid molecule is fixed and elongated along its length on the planar surface. Claim 1, 25 and 48 of the instant application are drawn to a method of elongating, aligning or separating polymeric molecules comprising multiple steps, including placing the polymeric molecules in a carrier liquid, passing the molecules and liquid through a microchannel comprising a wall and controlling the elongation/alignment or separation of polymeric molecule through control of laminar flow and causing the molecule to adhere in a straightened configuration to the wall. Claims 4-7, 23-24, 29-31 and 45-47 of the instant application are directed to applying restricting enzymes or a second polymeric molecule to the straightened polymer and include steps of optical inspection of the polymer. The limitations disclosed in independent claims 1, 25 and 48 in combination with the absorption and elongation of the polymeric molecule of claim 17 and 39, and in view of the reactions of claims 4-7, 23-24, 29-31 and 45-47, are disclosed generally in the method of claim 1.

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6. While the claims are not identical, the methods comprise straightening polymeric molecules generically (or nucleic acids specifically in the '074 patent) through fixing the polymers through electrostatic attraction between the polymer and the surface. In the '074 patent, the surface is planar and comprises a positively charged substance, while the instant application comprises a microchannel with a wall surface. The claims of the instant application and the '074 patent address a similar scope and breadth of a method of fixing and straightening of polymers or nucleic acids such that the claims of the instant application are obvious over the claims of the '074 patent.

7. Claims 1, 3, 4-7, 17, 23-25, 27-31, 39, 45-48 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-2, 10, 12-13, 15-16, and 26-27 of U.S. Patent No. 6,509,158, issued January 2003 ('158 patent herein). Although the conflicting claims are not identical, they are not patentably distinct from each other.

8. Claim 1 of the '158 patent is directed to a method of characterizing a nucleic acid molecule comprising imaging the nucleic acid molecule, which is elongated and fixed along its length on a solid planar surface so that said nucleic acid molecule is individually accessible to enzymatic reactions. Claim 1, 25 and 48 of the instant application are drawn to a method of elongating, aligning or separating polymeric molecules comprising multiple steps, including placing the polymeric molecules in a carrier liquid, passing the molecules and liquid through a microchannel comprising a wall and controlling the elongation/alignment or separation of polymeric molecule through control of laminar flow and causing the molecule to adhere in a

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straightened configuration to the wall. Claims 4-7, 23-24, 29-31 and 45-47 of the instant application are directed to applying restricting enzymes or a second polymeric molecule to the straightened polymer and include steps of optical inspection of the polymer.

While the claims are not identical, the methods comprise straightening polymeric molecules generically (or nucleic acids specifically in the '158 patent) through fixing the polymers through electrostatic attraction between the polymer and the surface. In the '158 patent, the surface is planar while the instant application comprises a microchannel with a wall surface. The claims of both patents are also directed to optical or imaging analysis of the straightened polymers and include enzymatic analysis. The claims of the instant application and the '158 patent address a similar scope and breadth of a method of fixing and straightening of polymers or nucleic acids such that the claims of the instant application are obvious over the claims of the '158 patent.

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 19 and 41 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
3. The term "applying an acceleration" is vague and indefinite. While the specification discusses multiple types of accelerations, including centripetal, it is unclear how "an acceleration" is applied specifically to the width of the microchannel? Clarification is requested.

Claim Rejections - 35 USC § 102

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

10. Claims 1-9, 17-18, 21-31, 39-40, 43-46, 48 and 58-64 are rejected under 35 U.S.C. 102(e) as being anticipated by Bensimon et al. (US Patent 6,256,153; July 2001; filed February 10, 1995). Bensimon teaches a process for aligning a macromolecule onto the surface of a support comprising fixing one end onto the surface (Abstract).

With regard to claim 1, Bensimon teaches a method for elongating polymeric molecules comprising the steps of:

(a) passing a liquid and polymeric molecule through a micro-channel sized to provide laminar flow of the liquid along a micro-channel length (Example 1, col. 17, lines 18-55, where the anchoring and fixing of the polymeric molecule is disclosed, including the solution comprising the molecule between two cover slips, which provides a channel for the movement of the DNA molecules; see also Figure 6, where the fixing and passage of the molecule is schematically depicted; legend, col. 2, lines 17-20); and

(b) controlling the flow of liquid to cause elongation of the polymeric molecule within the laminar flow (Example 1, col. 17, lines 39-46, where capillary force on the DNA molecule(s) is sufficient to stretch the molecule; col. 4, lines 4-6, where it is noted that one aligned, the molecules adhere strongly to the surface).

With regard to claim 25, Bensimon teaches a method for aligning polymeric molecules comprising the steps of: (a) passing a liquid and a plurality of polymeric molecules through a micro-channel sized to provide laminar flow of the liquid along a micro-channel length (Example 1, col. 17, lines 18-55, where the anchoring and fixing of the polymeric molecule is disclosed, including the solution comprising the molecule between two cover slips, which provides a channel for the movement of the DNA molecules; see also Figure 6, where the fixing and passage of the molecule is schematically depicted; legend, col. 2, lines 17-20); and (b) controlling the flow of liquid to cause alignment of the polymeric molecules within the laminar flow (Example 1, col. 17, lines 39-46, where capillary force on the DNA molecule(s) is sufficient to stretch the molecule; col. 4, lines 4-6, where it is noted that one aligned, the molecules adhere strongly to the surface).

With regards to claim 48, Bensimon teaches a method for separating polymeric molecules of differing molecular weight comprising the steps of:

(a) passing a liquid and polymeric molecules through a micro-channel sized to provide laminar flow of the liquid along a micro-channel length (Example 1, col. 17, lines 18-55, where the anchoring and fixing of the polymeric molecule is disclosed, including the solution comprising the molecule between two cover slips, which provides a channel for the movement of the DNA molecules; see also Figure 6, where the fixing and passage of the molecule is schematically

depicted; legend, col. 2, lines 17-20); and

(b) controlling the laminar flow of liquid to separate the polymeric molecules of differing molecular weights (col. 12, lines 15-35, where it is noted that it is possible to separate molecules and to establish size and the distance between fragments).

With regard to claim 2, 26, Bensimon teaches an embodiment of claim 1, 25, wherein the micro-channel has a cross-sectional dimension within one order of magnitude of a relaxed diameter of the polymeric molecule (Example 1, col. 17, lines 18-55, where the anchoring and fixing of the polymeric molecule is disclosed, including the solution comprising the molecule between two cover slips, which provides a channel for the movement of the DNA molecules; see also Figure 6, where the fixing and passage of the molecule is schematically depicted; legend, col. 2, lines 17-20).

With regard to claim 3, 27, 64, Bensimon teaches an embodiment of claim 1, 25, 48, wherein the micro-channel includes a transparent wall and including the step of optically analyzing the elongated polymeric molecule suspended within the laminar flow (col. 10, lines 54-60, where the stretched molecules can be revealed by a variety of techniques, including optical fluorescence microscopy).

With regard to claim 4, 28, Bensimon teaches an embodiment of claim 1, 25, including the step of reacting the elongated polymeric molecule suspended within the laminar flow with a reactant (col. 9, lines 29-60, where the polymeric molecule within the laminar flow may be reacted with a variety of reactants, including DNA, RNA or proteins through hybridization or labeling; col. 12, lines 53-63, where the position of specific genes on genomic DNA are determined by hybridization with gene specific probes).

With regard to claim 5, 29, Bensimon teaches an embodiment of claim 4, 28, wherein the reactant is an enzyme causing cleavage of the polymeric molecule (col. 12, lines 53-58, where the polymer is genomic DNA and can be cleaved with restriction enzyme prior to further 'physical mapping' steps).

With regard to claim 6, 30, 62, Bensimon teaches an embodiment of claim 4, 28, 60, wherein the reactant is a second polymeric molecule reacting with at least one elongated polymeric molecule (col. 12, lines 53-63, where the position of specific genes on genomic DNA are determined by hybridization with gene specific probes; col. 13-14, where the polymeric molecule is amplified in situ by PCR amplification methods, together with hybridization with labeled probes).

With regard to claim 7, 31, 63, Bensimon teaches an embodiment of claim 6, 25, 57, wherein the polymeric molecules are DNA (col. 3, lines 20-27, where the polymer to be stretched or elongated or separated comprise biological polymers such as DNA).

With regard to claim 8, Bensimon teaches an embodiment of claim 1, wherein multiple polymeric molecules are simultaneously passed through the channel (col. 17, Example 1, lines 18-23, where the total number of molecules of fluorescence-labeled λ DNA was added in different buffers, wherein this constitutes multiple polymeric molecules simultaneously passed through the channel).

With regard to claim 9, Bensimon teaches an embodiment of claim 1, including the step of staging the polymeric molecule with a plurality of other polymeric molecules in the liquid before passage through the channel (col. 17, Example 1, lines 18-23, where the total number of

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molecules of fluorescence-labeled λ DNA was added in different buffers, wherein this constitutes multiple polymeric molecules simultaneously passed through the channel).

With regard to claim 17, 39. Bensimon teaches an embodiment of claim 1, 25, wherein at least a first wall of the micro-channel provides attraction to the polymeric molecule and further including the step of: (c) adsorbing of the polymeric molecule to the first wall of the micro-channel in straightened form (col. 3, lines 58-65, where the adsorption of the macromolecule onto the surface can be controlled through surface charges and the electrostatic interactions between the surface and the molecule; col. 4, lines 52-61, where specific types of surface functionalities are described; see also col. 5, lines 4-23, for example; and see Example 1, col. 17, lines 39-46, where capillary force on the DNA molecule(s) is sufficient to stretch the molecule; col. 4, lines 4-6, where it is noted that one aligned, the molecules adhere strongly to the surface).

With regard to claim 18, 40, Bensimon teaches an embodiment of claim 17, 39 wherein step (c) includes the steps of controlling the flow rate of the liquid and the size of the micro-channel to cause adsorption by random encounters between at least one end of the polymeric molecule and a wall of the micro-channel (col. 3, lines 58-65, where the adsorption of the macromolecule onto the surface can be controlled through surface charges and the electrostatic interactions between the surface and the molecule; col. 4, lines 52-61, where specific types of surface functionalities are described; see also col. 5, lines 4-23, for example; and see Example 1, col. 17, lines 39-46, where capillary force on the DNA molecule(s) is sufficient to stretch the molecule; col. 4, lines 4-6, where it is noted that one aligned, the molecules adhere strongly to the surface).

With regard to claim 21, 43, 58, Bensimon teaches an embodiment of claim 17, 39, 57 wherein the micro-channel includes an elastic channel material releasably adhered to an optical mapping surface to create the micro-channel between the elastic material and the optical mapping surface and wherein the adsorption is to the optical mapping surface (Example 3, col. 19, lines 21-26, where the coverslip is removed from the adhered molecules).

With regard to claim 22, 44, 59, Bensimon teaches an embodiment of claim 21, 43, 58, further including the step of separating the elastic channel material from the optical mapping surface after adsorption of the polymeric molecule to the optical mapping surface (Example 3, col. 19, lines 21-26, where the coverslip is removed from the adhered molecules).

With regard to claim 23, 45, 60, Bensimon teaches an embodiment of claim 17, 39, 57, further including the step of reacting the adsorbed polymeric molecule with a reactant (col. 9, lines 29-60, where the polymeric molecule within the laminar flow may be reacted with a variety of reactants, including DNA, RNA or proteins through hybridization or labeling; col. 12, lines 53-63, where the position of specific genes on genomic DNA are determined by hybridization with gene specific probes).

With regard to claim 24, 46, 61, Bensimon teaches an embodiment of claim 23, 45, 60, wherein the reactant is an enzyme causing cleavage of the polymeric molecule (col. 12, lines 53-58, where the polymer is genomic DNA and can be cleaved with restriction enzyme prior to further 'physical mapping' steps).

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11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

12. Claims 10-16, 20, 32-38, 42, 49-57, 65-70 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bensimon et al. (US Patent 6,256,153; July 2001) as applies to claims 1-9, 17-18, 21-31, 39-40, 43-46, 48 and 58-64 above and further in view of Chen et al. (US Patent 6,762,059; July 2004). Bensimon teaches a process for aligning a macromolecule onto the surface of a support comprising fixing one end onto the surface (Abstract).

With regard to claim 12, 34, 52, Bensimon teaches an embodiment of claim 10, 32, 50, wherein the micro-channel includes a transparent wall and including the step of optically analyzing the elongated polymeric molecule as it hovers within the laminar flow (col. 10, lines 54-60, where the stretched molecules can be revealed by a variety of techniques, including optical fluorescence microscopy).

With regard to claim 13, 35, 53, Bensimon teaches an embodiment of claim 10, 32, 50, including the step of reacting the elongated polymeric molecule hovering within the laminar flow with a reactant (col. 9, lines 29-60, where the polymeric molecule within the laminar flow may be reacted with a variety of reactants, including DNA, RNA or proteins through hybridization or labeling; col. 12, lines 53-63, where the position of specific genes on genomic DNA are determined by hybridization with gene specific probes).

With regard to claim 14, 36, 54, Bensimon teaches an embodiment of claim 13, 35, 53, wherein the reactant is an enzyme causing cleavage of the polymeric molecule (col. 12, lines 53-

58, where the polymer is genomic DNA and can be cleaved with restriction enzyme prior to further 'physical mapping' steps).

With regard to claim 15, 37, 55, Bensimon teaches an embodiment of claim 13, 35, 53, wherein the-reactant is a second polymeric molecule (col. 12, lines 53-63, where the position of specific genes on genomic DNA are determined by hybridization with gene specific probes; col. 13-14, where the polymeric molecule is amplified in situ by PCR amplification methods, together with hybridization with labeled probes).

With regard to claim 16, 38, 56, Bensimon teaches an embodiment of claim 15, 35, 55, wherein the polymeric molecules are DNA (col. 3, lines 20-27, where the polymer to be stretched or elongated or separated comprise biological polymers such as DNA).

With regards to claim 57, Bensimon teaches an embodiment of claim 49 further including the step of fixing the separated polymeric molecules to a substrate after their separation (col. 3, lines 58-65, where the adsorption of the macromolecule onto the surface can be controlled through surface charges and the electrostatic interactions between the surface and the molecule; col. 4, lines 52-61, where specific types of surface functionalities are described; see also col. 5, lines 4-23, for example; and see Example 1, col. 17, lines 39-46, where capillary force on the DNA molecule(s) is sufficient to stretch the molecule; col. 4, lines 4-6, where it is noted that one aligned, the molecules adhere strongly to the surface).

With regards to claim 66, Bensimon teaches an embodiment of claim 65 further including the step of fixing the elongated polymeric molecules to a substrate (col. 3, lines 58-65, where the adsorption of the macromolecule onto the surface can be controlled through surface charges and the electrostatic interactions between the surface and the molecule; col. 4, lines 52-61, where

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specific types of surface functionalities are described; see also col. 5, lines 4-23, for example; and see Example 1, col. 17, lines 39-46, where capillary force on the DNA molecule(s) is sufficient to stretch the molecule; col. 4, lines 4-6, where it is noted that one aligned, the molecules adhere strongly to the surface).

With regards to claim 69, Bensimon teaches an embodiment of claim 48 wherein the micro-channel has a cross-sectional dimension within one order of magnitude of a relaxed diameter of the polymeric molecule (Example 1, col. 17, lines 18-55, where the anchoring and fixing of the polymeric molecule is disclosed, including the solution comprising the molecule between two cover slips, which provides a channel for the movement of the DNA molecules; see also Figure 6, where the fixing and passage of the molecule is schematically depicted; legend, col. 2, lines 17-20).

Regarding claims 12-16, 34-38, 52-56, Bensimon does not teach the limitations of claims 10-11, 32-33, 50-51, wherein the flow of the polymeric molecules is reversed periodically to cause the polymeric molecule to hover in an elongated state. Bensimon also does not teach the limitations of claims 49, 57 and 65-70 as recited below.

With regard to claim 10, 32, 50, Chen teaches an embodiment of claim 1, 25, 48, including the step of periodically reversing the flow to cause the polymeric molecule to hover in an elongated state (col. 40, lines 41-67, where the movement of charged polymers such as DNA can be controlled through the application of an electric field and the flow can be reversed to assist in stretching of the polymer).

With regard to claim 11, 33, 51, Chen teaches an embodiment of claim 10, 32, 50, wherein the flow is periodically reversed at a rate from between 0.2-5 Hz (col. 40, lines 41-67,

where the movement of charged polymers such as DNA can be controlled through the application of an electric field and the flow can be reversed to assist in stretching of the polymer).

With regard to claim 20, 42, Chen teaches an embodiment of claim 17, 39, wherein step (c) includes the step of applying an electrostatic field across the width of the micro-channel to cause adsorption of the polymeric molecule to one wall of the micro-channel (col. 40, lines 41-67, where the movement of charged polymers such as DNA can be controlled through the application of an electric field and the flow can be reversed to assist in stretching of the polymer).

With regards to claim 49, Chen teaches an embodiment of claim 48 further including the step of controlling the flow of liquid to elongate the molecules and separate the elongated molecules by their relative speeds within the laminar flow (col. 17-18, where the elongated molecules are analyzed with regard to their relative speed or 'center of mass' velocity within the flow of the apparatus of the invention; see col. 15, lines 41-52, where the invention provides structures for the stretching and elongation of polymers).

With regards to claim 65, Chen teaches an embodiment of claim 48 further including the step of controlling the flow of liquid to cause elongation only of the polymeric molecules of a predetermined molecular weight range within the laminar flow (col. 38, lines 10-21, where the size of molecules of interest range from several kilobases to at least a megabase of DNA).

With regards to claim 67, Chen teaches an embodiment of claim 65 further including the step of controlling the flow of liquid to separate the elongated and unelongated molecules as a function of their differing speed within the laminar flow and to separate the elongated molecules

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from the unelongated molecules by their different speeds in the laminar flow (col. 37, Figure 23, where polymers of a particular length remain elongated, while polymers of a different length recoil and are no longer elongated and these molecules traverse different and separate paths in the substrate).

With regards to claim 68, Chen teaches an embodiment of claim 65 further including the step of obtaining a digital image of the elongated and unelongated molecules and separating them by image processing (col. 45, lines 10-39, Example 1, where digital images were obtained and both elongated and unelongated molecules were analyzed).

With regards to claim 70, Chen teaches an embodiment of claim 48 further including the step of controlling the flow of liquid to separate the molecules as a function of their propensity to be adsorbed as a function of their length while moving in the laminar flow (col. 37, Figure 23, where polymers of a particular length remain elongated, while polymers of a different length recoil and are no longer elongated and these molecules traverse different and separate paths in the substrate).

It would have been *prima facie* obvious to one of ordinary skill in the art at the time the invention was made to have extended the teachings of Bensimon to incorporate the additional methods of polymer stretching and elongation of Chen to arrive at the claimed invention with a reasonable expectation for success. Both Bensimon and Chen disclose methods that are directed to the separation, elongation and analysis of polymers as they pass through a microchannel passageway. Regarding the issue of reversing the flow of the passage of the polymeric molecules, as taught by Chen, "the movement of the polymer is controlled, for charged polymers such as DNA, by setting up an electric field which acts on the charges on the polymer... and the

polymer follows the electric field lines". Chen also teaches "in addition, with an appropriately charged wall surface, the electro-osmotic flow can be reversed to provide viscous forces which assist the osmotic stretching" (col. 40, lines 41-67). While Bensimon does disclose a charged surface, and the control of the liquid flow, there is no specific teaching of an attempt to reverse the flow of the liquid, or to include an electrical field as an additional level of control of fluid flow and elongation of the polymers. However, as Chen teaches that the flow can be reversed and assist stretching, one of ordinary skill in the art at the time the invention was made would have been motivated to incorporate the additional steps of reversing the flow as taught by Chen into the method of elongation, separation and alignment taught by Bensimon with a reasonable expectation for success.

Furthermore, it would have been prima facie obvious to have extended the teachings of Bensimon to incorporate the additional methods of polymer stretching and elongation of Chen to arrive at the claimed invention with a reasonable expectation for success. Both Bensimon and Chen disclose methods that are directed to the separation, elongation and analysis of polymers as they pass through a microchannel passageway. Regarding the separation of molecules according to their relative speeds in the laminar flow, as taught by Chen, "the present invention also provides methods and structures that allow polymers of any length, including nucleic acids containing entire genomes, to be stretched or elongated for further analysis, e.g., determination of their velocities and lengths. Polymers are loaded into a device and run through the structures, propelled by, inter alia, physical, electrical or chemical forces" (col. 15, lines 41-52). These teachings generally address the issue of control of the flow and the speed of the molecules. Chen also states that their method addresses "a need for more accurate methods for determining the

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length of single elongated polymers and/or determining the length of single elongated polymers and/or distances between landmarks on single elongated polymers". Therefore, while both Chen and Bensimon teach methods directed to the characterization of polymers, specifically DNA, Chen addresses the method from a different perspective than Bensimon, specifically aimed at the analysis of single molecules relative to their length and their velocity. Considering the combined teachings of these references, one of ordinary skill in the art at the time the invention was made would have been motivated to apply the techniques of analyzing and separating elongated polymers based on their velocities within the laminar flow as taught by Chen with a reasonable expectation for success.

Conclusion

No claims are allowed.

Claims 19 and 41 are free of the prior art. The closest prior art, Bensimon does not teach the application of an acceleration across the width of the microchannel. These claims stand rejected for other reasons as stated above.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Stephanie K. Mummert, Ph.D. whose telephone number is 571-272-8503. The examiner can normally be reached on M-F, 9:00-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gary Benzion can be reached on 571-272-0782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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